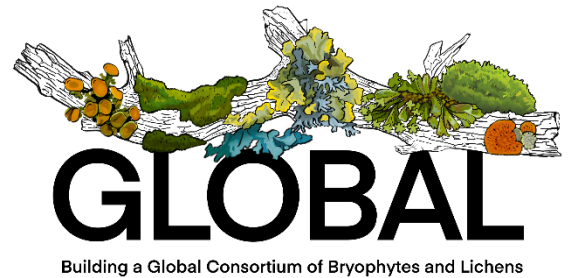




# TCN Quarterly Progress Report

## TCN Name

Building a global consortium of bryophytes and lichens:  
keystones of cryptobiotic communities (GLOBAL)<sup>1</sup>



## Person Completing the Report

Miranda Zwingelberg (GLOBAL Project Manager)

## Share Progress in Digitization Efforts

This report covers progress completed during the period of January 1 – March 31, 2024.

### Workflows, Equipment, and Personnel

Most GLOBAL institutions continued steady GLOBAL progress during 2024-Q1.

ALA continued imaging and transcribing lichens and bryophytes.

Specimen digitization continued at ASU, focusing on lichen specimens. Student worker Mrinaal Arora continues routine specimen digitization and has been uploading the chromatograms of lichen secondary metabolites from the Atlas of Felix Schumm to the Consortium. Curatorial assistant Frauke Ziemmeck was hired with funds secured independently from the GLOBAL project and recently completed re-organizing the entire collection, main herbarium, type collection, exsiccatae collection. All specimens receive new barcodes to make sure that legacy loans from the Sonoran Project are completely returned and again integrated into the collections.

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<sup>1</sup> Throughout this report, herbaria are referred to by their Index Herbariorum acronyms, which correspond to institutional names as follows: ALA = University of Alaska, Fairbanks, ASU = Arizona State University, BISH = Bishop Museum, BRY = Brigham Young University, CINC & MU = University of Cincinnati & Miami University, COLO = University of Colorado, DUKE = Duke University, F = The Field Museum, FLAS = University of Florida, ILL & ILLS = University of Illinois at Urbana-Champaign & Illinois Natural History Survey, LSU = Louisiana State University, MICH = University of Michigan, MIN = University of Minnesota, MO = Missouri Botanical Garden, MSC = Michigan State University, NY = New York Botanical Garden, OSC = Oregon State University, PH = The Academy of Natural Sciences of Drexel University, PTBG = National Tropical Botanical Garden, TENN = University of Tennessee, Knoxville, UC = University of California, Berkeley, WIS = University of Wisconsin, YU = Yale University



At CINC, bryophytes, and lichens to a lesser degree, continue to be processed as specimens get moved from backlog into the collection by workers on the CINC CSBR grant.

At COLO, all lichen and bryophyte images and skeletal data captured through 3/31/2024 have been uploaded to the portal. 631 lichen transcriptions were completed. 4,957 bryophyte packets were barcoded and imaged and skeletal records created. 464 bryophyte transcriptions were completed.

DUKE barcoded 739 bryophyte specimens, imaged 853 labels and 144 plants in the first quarter of 2024. All images and skeletal data have been uploaded to the bryophyte portal. They fully transcribed 124 specimens, and georeferenced 12.

In 2024-Q1, F continued to barcode (5,300), digitize (over 1,500) and database (over 6,300) bryophyte specimens, while prioritizing lichen imaging. They are also working with a computer science undergraduate and retired surface scientist investigating the utilization of Chat GPT to aid in the process of transcription using Python. F completed photography of Lumbsch collection lichen specimens. Skeletal records of these specimens are 90% completed (9,159 specimens so far) and imported to EMu. Upon completion of the skeletal records, these will all be uploaded to the lichen portal. Fully georeferenced collections from Sri Lanka, Taiwan, Sweden, and Puerto Rico (336 in total) were also imported to EMu and will be added to the portal soon.

At FLAS, bryophyte imaging progress is on genera starting at “We”, proceeding to Z, then liverwort, hornworts, on to lichens. Transcribing efforts ramped up, with the largest amount done so far.

LSU added 4 new lichens to the portal. Over 1,000 georeferences of LSU’s lichens and bryophytes were completed by Julie’s remote team at WIS.

MICH finished the last of the bryophyte specimen imaging, minus specimens from old loan returns. They have about 10k more specimens than originally estimated.

MO barcoded 4,432 bryophyte specimens. They also imaged 10,561 bryophyte labels and 4,270 bryophyte specimens. They created 10,561 skeletal records, fully transcribed 596 labels, and also georeferenced 149 specimens.

NY continued barcoding, imaging, transcribing, and georeferencing bryophyte and lichen specimens.



In 2024-Q1, OSC imaged 1,724 lichen specimens.

At PH a post-bacc intern has been working on repackaging, barcoding, and databasing bryophyte packets that are pinned to sheets.

PTBG produced 7,305 images (each image is a composite of stacked images) representing 3,179 specimens of mosses and hepatics. They finished all the hepatic collections currently in the collection.

At TENN, the Collections Manager trained four new undergraduate technicians. Lead Digitizer Alex Dowd has been combing through the bryophyte collection and imaged 646 additional specimens that were missed during the first pass.

UC students made great progress in their bryophyte specimens and are getting close to the end of imaging!

Students continued imaging WIS specimens and are making progress with transcribing BRU bryophytes.

YU continued transcribing label data. Undergraduate students and volunteers generated 2,377 fully transcribed records.

## **Digitization**

Nineteen institutions (ALA, ASU, BISH, CINC & MU, COLO, DUKE, F, FLAS, LSU, MICH, MO, NY, OSC, PH, PTBG, TENN, UC, WIS, and YU) reported progress on digitization deliverables, with a GLOBAL team total of 31,508 specimens barcoded (25,824 bryophytes and 5,684 lichens), 46,649 labels imaged (38,611 bryophytes and 8,038 lichens), 29,929 specimens imaged (20,011 bryophytes and 9,918 lichens), 20,324 specimen records uploaded to the portal (16,510 bryophytes and 3,814 lichens), 42,806 skeletal records created (38,023 bryophytes and 4,783 lichens), 33,400 labels fully transcribed (22,570 bryophytes and 10,830 lichens), and 33,408 specimens georeferenced (21,009 bryophytes and 12,399 lichens) (See Table 1 & Figure 1).

PEN partners BISH and PTBG both reported progress for 2024-Q1. At BISH, a total of 1,187 specimens were barcoded (1,131 bryophytes and 56 lichens), 1,187 labels were imaged (1,131 bryophytes and 56 lichens), 3,556 specimens were imaged (3,500 bryophytes and 56 lichens), 1,187 skeletal records were created (1,131 bryophytes and 56 lichens), and 1,187 labels were fully transcribed (1,131 bryophytes and 56 lichens). At PTBG, a total of 339 specimens were barcoded (117 bryophytes and 222 lichens), 3,179 labels were imaged (all bryophytes), 3,179 specimens were imaged (all bryophytes), and 133 labels were fully transcribed (42 bryophytes and 91 lichens).



	# Barcodes Added		# Labels Imaged		# Specimens Imaged		# Uploaded to Portal		# Skeletal Records Created		# Fully Transcribed		# Georeferenced	
	B	L	B	L	B	L	B	L	B	L	B	L	B	L
ALA						2,095			25		41			
ASU		997		997		837		837		837		837		
BRY														
CINC & MU	1,234	107	441	106	441	106	559	107	1,234	107	1,153	2		
COLO	8,021	379	8,021	379			8,021	379	8,021	379	580	1,037		
DUKE	2,758		3,261		345		3,606		2,758		347		32	
F	2,185	1,333	2,521	5,990	2,521	5,990	2,521		5,512	1,592	4,116	742		452
FLAS			2,531		2,531		2,531				1,196			
ILL & ILLS											100			
LSU	146	134	146	171	533		146	134	146	134	435	208	356	597
MICH	9,405		9,405		1,045		2,020		9,405			680		16
MIN												18,312		
MO	4,726		4,672		4,672				4,672		677		194	
MSC														
NY														
OSC														
PH	318						318		318		318		213	
TENN	1,683	3	1,742	3	1,742	3	1,742	3	1,669	3	2,110	8	1,285	2
UC	250		3,629		3,629				3,629					
WIS					200	1,984	898	535	230		646		11,757	8,870
YU											1,363			
<b>Totals</b>	<b>30,726</b>	<b>2,953</b>	<b>36,369</b>	<b>7,646</b>	<b>17,659</b>	<b>11,015</b>	<b>22,362</b>	<b>1,995</b>	<b>37,619</b>	<b>3,052</b>	<b>13,082</b>	<b>21,826</b>	<b>13,837</b>	<b>9,937</b>
<b>B+L Totals</b>		<b>33,679</b>		<b>44,015</b>		<b>28,674</b>		<b>24,357</b>		<b>40,671</b>		<b>34,908</b>		<b>23,774</b>

Table 1: Digitization progress by GLOBAL collaborators in 2024-Q1, separated by Bryophyte (B) and Lichen (L) specimens.

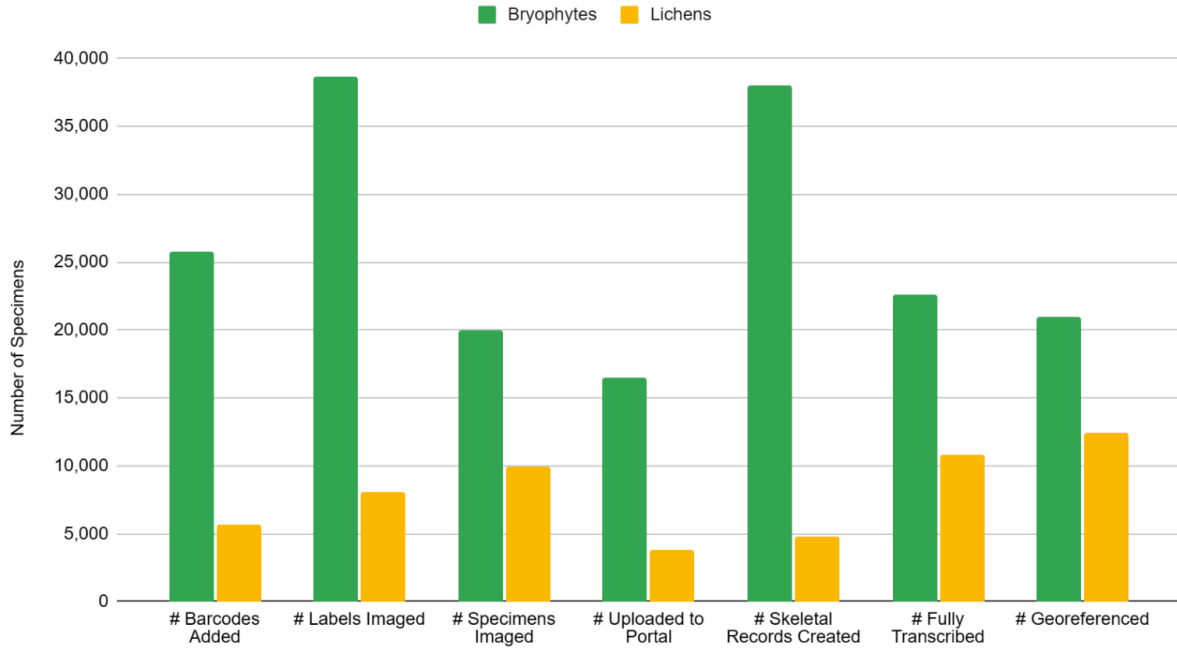


Figure 1: Digitization progress for the GLOBAL collaboration in 2024-Q1, separated by Bryophyte and Lichen specimens.

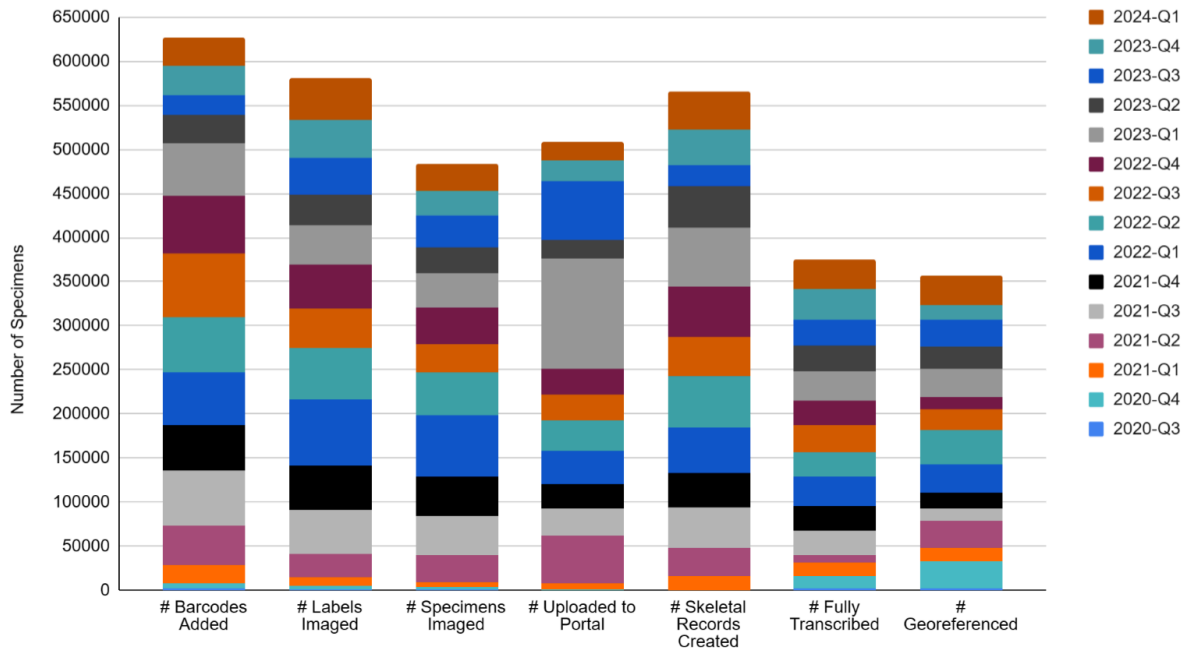


Figure 2: Cumulative digitization progress for the GLOBAL collaboration by quarter.



## Share Best Practices, Standards, and Lessons Learned

### Flexible Workflows

The GLOBAL teams continued to make use of flexible digitization workflows in 2024-Q1, including a mixture of virtual and on-site work.

### Collaboration

Team members continued to make use of Basecamp, Zoom, and email to communicate and collaborate during 2024-Q1. New collaborators and students were given access to Basecamp group resources. The Outreach & Education Group met in March to discuss possible GLOBAL participation in the April WeDigBio event. A Management Committee Meeting was held in February open to all GLOBAL members to review progress from 2023-Q4, and to provide an open forum to the GLOBAL team.

WIS continued its collaborative georeferencing, creating new communities in the CoGe interface and georeferencing as fully transcribed records become available. The GLOBAL Georeferencing Manager (WIS) and Portal Manager (ASU) continued to consult on georeferencing workflows, especially those involving GEOLocate CoGe.

## Share Identified Gaps in Digitization Areas and Technology

### New Software Tools

Updates to programs provided by ASU as part of the grant (BCRWatcher, Mytabolites) are regularly made available. The newest version of Mytabolites (1.0.1.4) now includes an integrated image viewer with detailed chromatograms for 598 secondary metabolites from the Atlas of Chromatograms of Lichen Substances published by German lichenologist Felix Schumm. These chromatograms were uploaded to the Glossary together with the reference data, an example is [atranorin](#). When an internet collection is available Mytabolites can access this data and display the chromatogram in its integrated image viewer.

ASU is in the final stages of developing a tool that will enable portal users to search across multiple Symbiota portals at one time from a single interface. This will allow users to map, e.g., lichens and bryophytes on one map. This tool is currently in alpha testing with several GLOBAL TCN users.

F is working with a computer science undergraduate and retired surface scientist investigating the utilization of Chat GPT to aid in the process of transcription using Python.



## Share Opportunities to Enhance Training Efforts

The GLOBAL Project Manager (TENN) and Georeferencing Manager (WIS) continued compiling resources during 2024-Q1 to share on Basecamp and all resources were posted to the project website (<https://globaltcn.utk.edu>).

ASU continues to provide regular user support through the Symbiota Support Hub. [Monthly Monday meetings by the Support Group](#) are open to all members of the Symbiota community and generally well attended. Symbiota tutorials continue to be added to the Symbiota Documentation by the Symbiota Support Hub at <https://biokic.github.io/symbiota-docs/>. For April and May a Portal Campaign is being planned to share new features with the GLOBAL community. The campaign will reach out to the international community of lichenologists and bryologists, hoping that more international collections will join the Consortia. The results may be presented at the annual meeting of the American Lichenological and Bryological Society (ABLS) in the summer.

For the annual meeting of the Grupo Latinoamericano de Liquenólogos (GLAL XVI) in the Ciudad de México this October a round table and workshop are planned to encourage more Latin American lichen collection to join the Consortium.

## Share Collaborations with other TCNs, Institutions, and/or Organizations

International institutions and collaborators continue to join the Consortium of Lichen Herbaria. It is anticipated that additional collections will join as a result of the Portal Campaign planned for April-May. F. Bungartz (ASU) is leading regular monthly meetings with a group of Mexican lichenologists from the Universidad Nacional Autónoma de México (UNAM), the Benemérita Universidad Autónoma de Puebla, and the Universidad de Sonora. In preparation for an International Workshop at the meeting of the Grupo Latinoamericano de Liquenólogos (GLAL) in Mexico City in October 2024, we are revising and updating the current [Checklist of Lichens and Lichenicolous Fungi of Mexico](#), shared through the Consortium.

Collaboration between GLOBAL teams and other TCN projects occurring concurrently at their sites continued. F is also a member of the tropical Africa TCN and hosted the lead PI Pete Townsend. CINC (also processing MU) is part of the All-Asia TCN, and workflows are shared between the two projects. COLO is also a member of the SoRo TCN and the All-Asia TCN. They continue to share info and technology between projects to help optimize workflows. MICH is participating in the All-Asia TCN, with shared workflows and best practices.

PTBG Began planning for September 2024 moss identification workshop with Jim Shevock from California Academy of Sciences.



## Share Opportunities and Strategies for Sustainability

### Portal Management

The Symbiota Support Hub at ASU continued to provide portal management and maintenance, including uploading and linking images to GLOBAL collections, updating snapshot data from international partners to facilitate duplicate matching and import, and providing assistance with data cleaning and other issues.

### Symbiota API

The Symbiota Support Hub team at ASU continues to work on strategies to use the new API to facilitate data queries across different Symbiota platforms. ASU student worker Ramisa Zaman (undergraduate student, computer science major) continues her internship in Java and C++ programming to develop a prototype for a cross platform search for ecological data analysis.

## Share Education, Outreach, Diversity, & Inclusion (EODI)

### Activities

The GLOBAL TCN website (<https://globaltcn.utk.edu>) was maintained and updated with additional links to developed protocols and workflows. Social media accounts belonging to collaborators continued using #GlobalTCN as a way to share progress with the community.

ALA PI Ickert-Bond gave several herbarium tours to undergraduate students and the public. We also hosted an Open House on March 23 with ~1200 visitors coming through the herbarium looking at selected specimens.

Throughout the spring semester F. Bungartz taught lichenology at ASU, a class offered to undergraduate and graduate students each spring. As part of this class students learn to collect, curate and identify lichen specimens, using the Personal Collections module built into the Consortium for data management of their specimens. Students thus learn how to use the tools offered by Symbiota to manage their own collection data, create dynamic checklists of collection sites, review taxon profiles, use the online keys, and browse the ASU collection for reference material. The ASU Lichen Herbarium regularly attends to visitors interested in learning about the collection as the largest and most representative lichen herbarium in the Southwest. Under the supervision of F. Bungartz, at the Universidad de Sonora in Hermosillo, Mexican student Eduardo Gutierrez is finishing his licenciatura thesis on coastal lichen diversity in the Mexican states Sonora, Baja California, and Baja California Sur. He recently got accepted into the master's program at ASU and plans to start his graduate degree with F. Bungartz in August.

DUKE's B. Aguero gave multiple herbarium tours to undergraduate students and the public, including homeschooled high school students and their families. She also organized the





Blomquist Foray (Mar 15-17) for 28 participants and agreed on next year's foray plans. Aguero gave a "Botany Spotlight: Mosses of Duke Gardens" short lecture followed by a moss walk for 18 public participants, on Mar 19. DUKE's S. LaGreca gave a "Botany Spotlight: Lichens" lecture and lichen walk through Duke Gardens on Feb 24. J. Shaw taught a 10-hr online course "Ecology and Evolution of Peatmosses" for over 20 participants for Eagle Hill Institute.

F led multiple tours for undergraduate students and high school students. They hosted Collections Club in January and prepared for the April WeDigBio event. Both activities have volunteers working on pre-curation or curation activities focused on bryophytes that benefit the GLOBAL TCN. An undergraduate and technician have also been collaborating with the Learning Center to finalize lesson plans, outreach resources using online platforms that will be hosted at fieldmuseum.org. F's Von Konrat is also finalizing a manuscript for peer review that describes the journey, process, and procedures for WeDigBio and Collections Club.

MICH gave herbarium tours to ca. 800 undergraduate students and highlighted the digitization projects.

PTBG posted on our social media accounts (X, Facebook, Instagram) about a new moss species found on Kaua'i. They highlighted the TCN digitization project using #globalTCN.

TENN Lead PI Budke gave a talk at the Knoxville Botanical Garden and Arboretum titled "Mysterious Mosses" and discussed the GLOBAL TCN. The TENN Herbarium also hosted another "Specimens and Scones" open house in February.

UC shared the importance of Herbaria and digitization at "Cal Day" on campus, open to current and prospective students and members of the community.

## Share Information About Your Website and/or Portal Usage

The GLOBAL project website, <https://globaltcn.utk.edu>, was utilized by 274 users during 2024-Q1, including 48 from Europe, 13 from Asia, 8 from South America, 6 from Oceania, and 4 from Africa, and 2 from Central America (see Figure 3).

The Bryophyte and Lichen Portals, created as part of the original LBCC grant, host new images and data produced by the GLOBAL collaborators. 7,200 users visited the Bryophyte Portal, and 23,000 users visited the Lichen Portal during 2024-Q1 (see Figures 4 & 5).

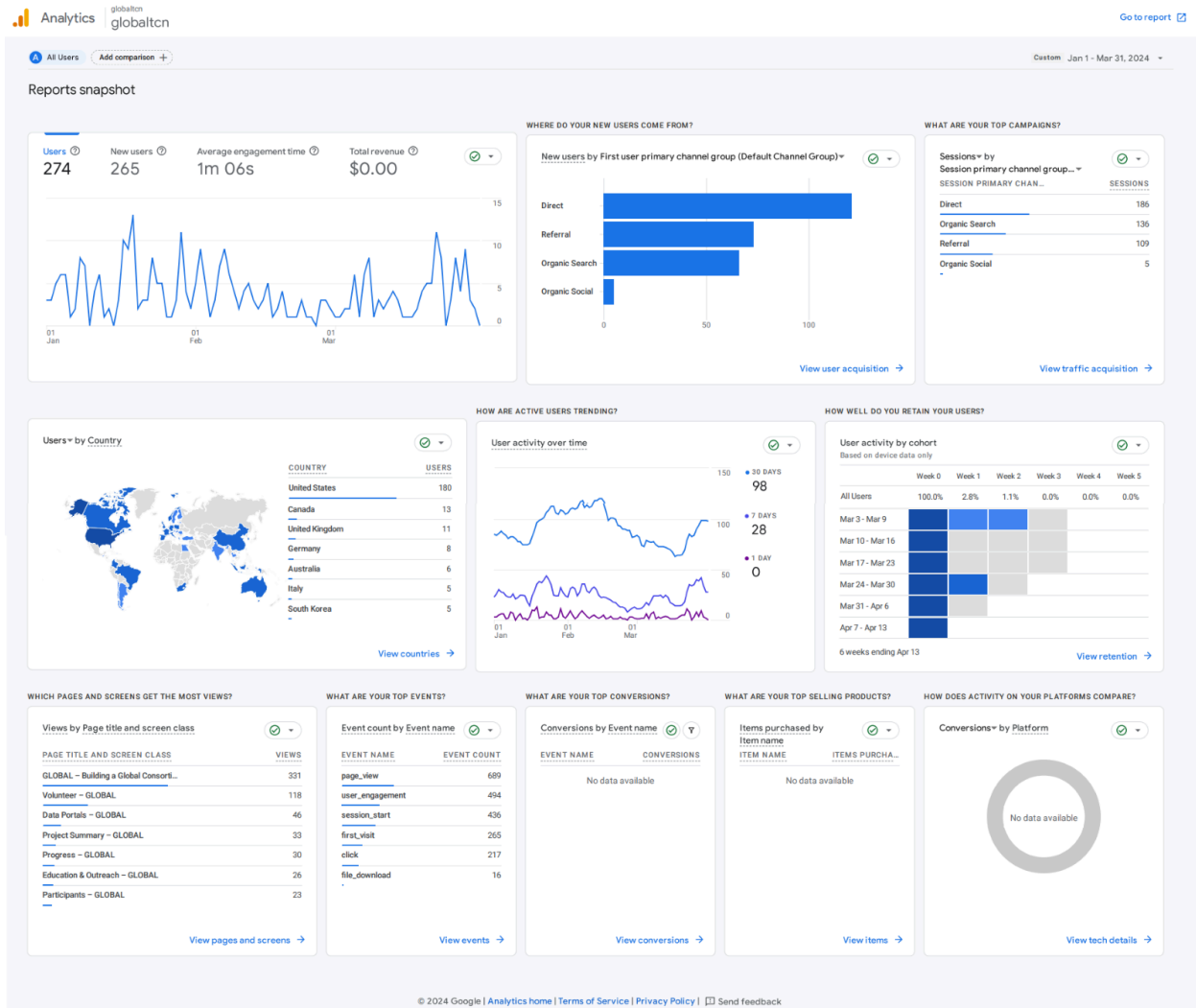


Figure 3: Use metrics for the GLOBAL project website (<https://globaltcn.utk.edu>) from January 1 – March 31, 2024.

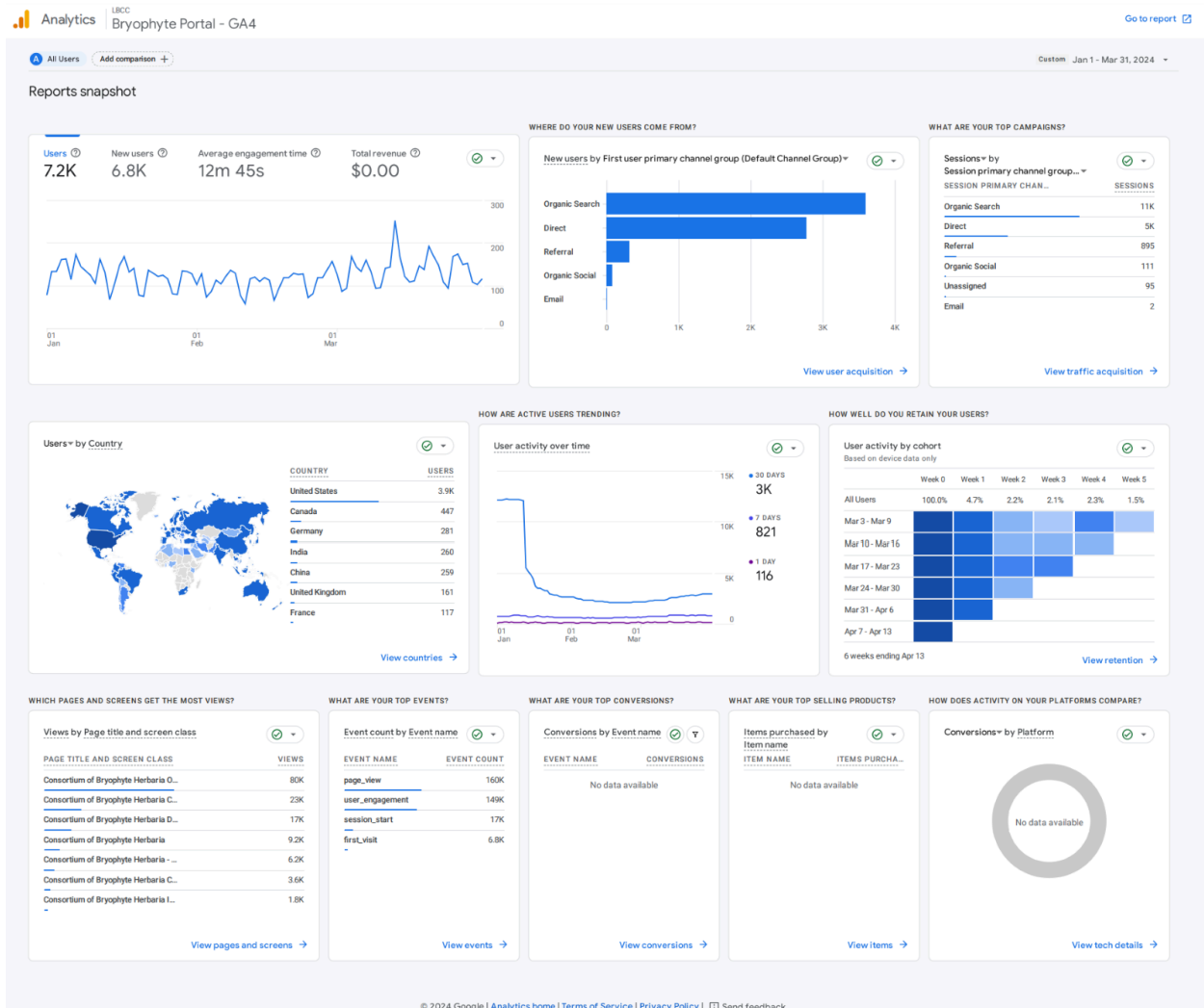


Figure 4: Use metrics for the Bryophyte Portal (<https://bryophyteportal.org/portal/>) from January 1 – March 31, 2024.

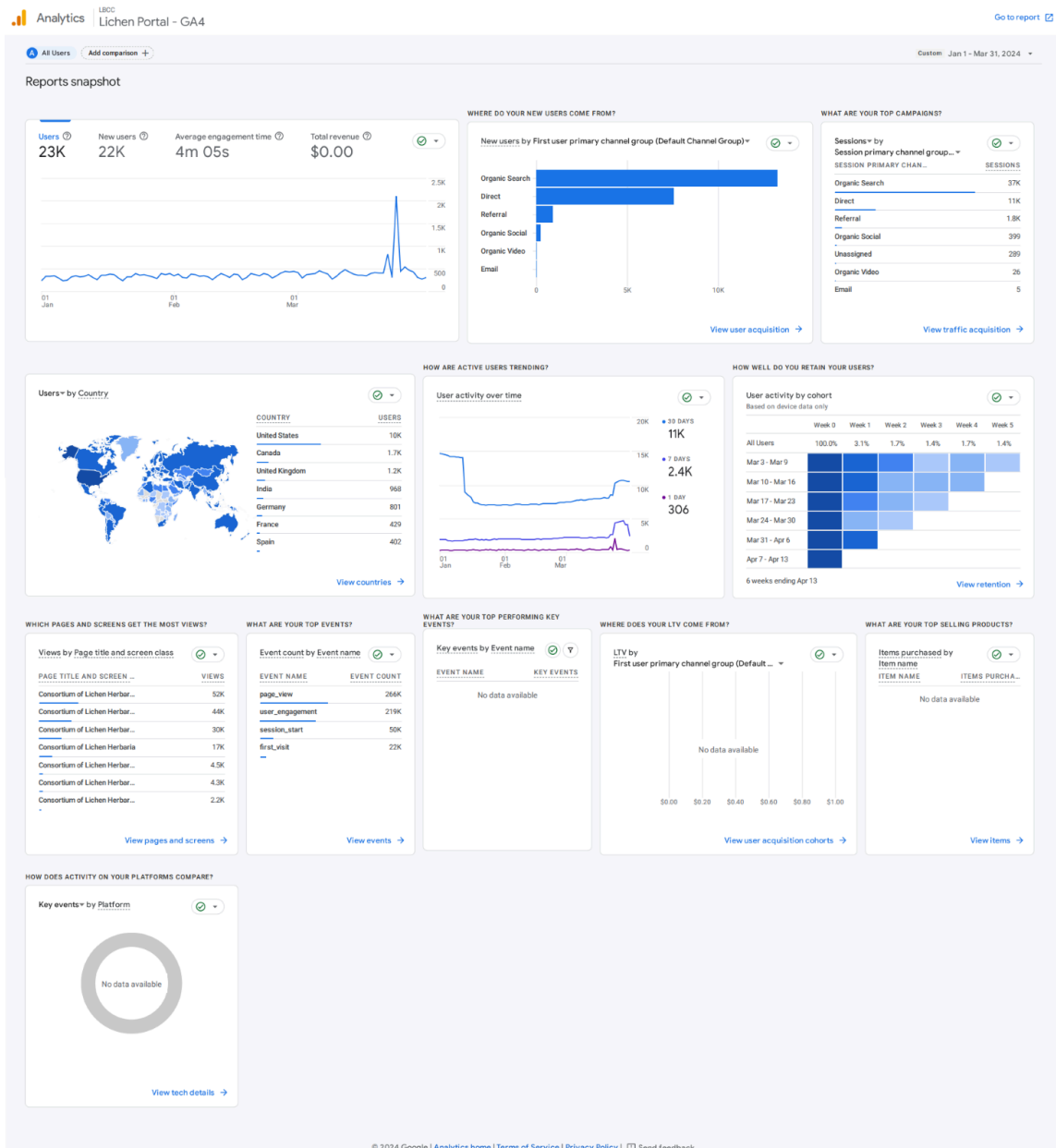


Figure 5: Use metrics for the Lichen Portal (<https://lichenportal.org/cnalh/>) from January 1 – March 31, 2024.



## Share Other Activities and/or Progress

### Image Tagging

Progress continued at ASU on character revision for tagging and identification keys and the glossary. A draft Controlled Vocabulary for import into Image Cataloging Software is currently being reviewed and tested. The default image tagging categories in the Consortia of Lichen and Bryophyte Herbaria have just been updated. Images from German lichenologist Felix Schumm continued to be processed/tagged for upload into the Consortium. Updating the taxon profiles of North American species of Rinodina from a monograph published by John Sheard is almost complete.

### Specimen Exchange

WIS identified a duplicate lichen exsiccata in their collection and were able to set up an exchange with CINC for a bryophyte exsiccata.